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## CHAPTER 1

# Executive Summary

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Castings are essential building blocks of U.S. industry. More than 90% of all manufactured, durable goods and 100% of all manufacturing machinery contain castings. Suppliers of components to durable goods manufacturing industries exist in a complex and competitive market. A given component may compete not only with castings made using other methods or other metals, but also metal components made using other fabrication techniques and components made of non-metallic materials. In this dynamic environment, existing markets for castings are changing and new ones are expected to emerge. To stay competitive under these conditions, the industry must continue to develop techniques to improve the products and processes it offers its customers.

Partnerships between the metalcasting industry, its suppliers, and its customers will be critical to successfully meeting the competitive challenges of the industry. Technology advancement plays an important role in lowering production costs, improving energy efficiency, enhancing environmental quality, and creating innovative new cast products. Intense competition within the industry for historically low-value-added, low-profit-margin markets, as well as competition with other materials and processes, limits resources for R&D investment. The future competitiveness of the U.S. metalcasting industry requires the combined resources and talents of industry, academia, and government.

Metalcasting industry leaders have been leveraging limited resources with cooperative partnerships as a way of maximizing investments in advanced technologies to solve pre-competitive technical problems and create new applications for castings. In September 1995, the metalcasting industry published its vision for meeting future challenges. This vision entails enlarging the application of metalcasting technology and expanding its usefulness to society through improvements in energy efficiency, cost minimization, and other innovations. *Beyond 2000: A Vision for the American Metalcasting Industry*, provides the framework for the metalcasting industry to become more competitive, productive, and efficient by the year 2020. The industry affirmed its commitment to the goals outlined in this document by making a compact with the U.S. Department of Energy that was signed by Secretary of Energy Hazel O'Leary and representatives from three major metalcasting technical societies in October, 1995.

While *Beyond 2000* identifies major needs of the metalcasting industry, it does not present a detailed technology strategy to achieve the vision. The industry has therefore prepared this *Metalcasting Industry Technology Roadmap* to provide a blueprint of the technology milestones needed to achieve the goals outlined in the vision. The *Roadmap* represents the critical link between the broadly defined strategic goals contained in *Beyond 2000* and the detailed research portfolio that will be pursued through industry/government partnerships and other mechanisms.

In June 1997, the U.S. Department of Energy, the American Foundrymen's Society, the Steel Founders' Society of America, the North American Die Casting Association, and the Cast Metal Coalition sponsored

the *Metalcasting Industry Technology Roadmap Workshop*. This event brought together experts from the metalcasting industry, some major customers, academia, and the national laboratories to identify key targets of opportunity, technology barriers, and priority research needs for the metalcasting industry. The core of the workshop was facilitated work sessions in which participants explored in detail the areas of products and markets, materials technology, manufacturing technology, and environmental technology.

The work sessions resulted in over 100 research ideas which were then assigned some level of priority by the industry. Exhibit 1-1 lists the highest priority research needs identified in each of the four major areas. The appropriate time frame—near (0 - 3 years), mid (3 - 10 years), and long (beyond 10 years)—in which the research activity is expected to yield benefits has been noted for each activity. The anticipated role for government (and in some cases, industry) in supporting selected research activities has also been identified. In some of the areas, important interrelationships and linkages among research activities have been identified.

This *Roadmap* document includes the results of the workshop and incorporates material from an earlier roadmap report that was prepared with help from the major metalcasting industry technical societies. The current *Roadmap* contains the following sections:

- Products and Markets
- Materials Technology
- Manufacturing Technology
- Environmental Technology
- Human Resources
- Profitability and Industry Health
- Partnerships and Collaborations
- Relevant Industry R&D Projects (Appendix)

For each of the areas listed above, the *Roadmap* discusses the current situation of the industry, the critical trends and driving forces affecting it, the performance targets given in the *Beyond 2000*, the technical and other barriers preventing the industry from achieving these performance targets, and the research and development activities that the industry has recommended for overcoming the barriers. Instead of listing R&D activities, the last three sections discuss how the issues of human resources, profitability, and partnerships can be integrated with the rest of the *Roadmap*.

Numerous interrelationships exist between the issues discussed in the *Roadmap*. For example, although quality and lead time are discussed under “Manufacturing Technology,” they directly impact the industry’s ability to maintain existing markets and capture new ones. These interrelationships are noted in the discussions for the appropriate sections.

The research priorities outlined in this *Roadmap* will be used as the basis for making new research investments by government and industry. However, the *Roadmap* is a dynamic document that will be reevaluated at regular intervals to incorporate new market and technical information and to ensure that the research priorities remain relevant to customer needs.

### Exhibit 1-1. Selected High Priority Research Needs for the Metalcasting Industry

Products and Markets	Materials Technology	Manufacturing	Environmental
<p>Transform foundries to tier-one suppliers</p> <p>Develop computer design tools to move from design concept to a design for manufacturing</p> <p>Develop methods to encourage/systematize concurrent engineering partnerships within the metalcasting industry</p> <p>Develop ways to demonstrate the quality and value of castings</p> <p>Develop tools and technologies to reduce lead times in the metalcasting industry</p>	<p>Develop quantitative relationships between alloy chemistries, properties, and processing</p> <p>Establish standard methodologies for materials testing</p> <p>Develop a clean melting and remelting process</p> <p>Develop methods for fast, accurate, and non-destructive evaluation of ingot and as-cast chemistries and properties (particularly for ferrous castings)</p> <p>Develop improved techniques to measure the acceptability of liquid metal prior to casting</p> <p>Develop a national initiative to foster interest in materials science and engineering</p>	<p>Develop low-cost rapid tooling technology</p> <p>Improve tooling design to reduce the time to get castings to market</p> <p>Develop cost-effective and dimensionally accurate patternmaking processes for use in sand casting</p> <p>Improve the ability to produce size/dimension</p> <p>Develop smart controls and sensors for automation supervision</p> <p>Develop a systems approach to scheduling and tracking</p> <p>Figure out how die casting molds/dies actually fill</p> <p>Understand folds for aluminum lost foam casting</p> <p>Develop melting and pouring technologies that do not introduce gases to the process</p> <p>Develop a mathematical model that describes process control and can control the machine</p>	<p>Develop environmentally benign, dimensionally stable molding materials for sand casting</p> <p>Develop new uses for wastes streams and/or new ways to treat wastes to make them more usable</p> <p>Develop emissions database for foundries to use to educate regulators</p>

